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Presentation of the Content

In the first chapter we present, *Solar pumps: a sustainable alternative for agricultural systems in areas of high marginalization* by MONTEMAYOR-TREJO, José Alfredo, WOO-REZA, José Luis, YESCAS-CORONADO, Pablo and FRIAS-RAMIREZ, Ernesto with adscription in the Instituto Tecnológico de Torreón, as a second article we present *Traditional management of Agave used for mezcal and its associated knowledge: the case of Oaxaca and Aguascalientes, México* by PARDO-NÚÑEZ, Joaliné & SÁNCHEZ-JIMÉNEZ, Eduardo with adscription in the Centro de Investigación y Asistencia en Tecnología y Diseño del Estado de Jalisco, A.C, as the following article we present *Generation of electric energy using natural water affluent through the design of a pelton turbine prototype* by ALONSO-GAETA, Reynaldo, AGUILAR-GONZÁLEZ, Alma Leticia, ZUÑIGA-NERIA, Capistrano and CASARRUBIAS-GUERRERO, Gabriel with affiliation at the Instituto Tecnológico Superior de Ciudad Hidalgo. as the following article we present. *Documentation of the marketing, maintenance and financing processes for an agribusiness company in southern Sonora*, by BELTRÁN-ESPARZA, Luz Elena, GONZÁLEZ-VALENZUELA, Elizabeth, FORNÉS-RIVERA, René Daniel and HIGUERA-CHAVEZ, María Paula, with adscription in the Instituto Tecnológico de Sonora.

Content

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Solar pumps: a sustainable alternative for agricultural systems in areas of high marginalization

Bombas solares: una alternativa sustentable para los sistemas agropecuarios en zonas de alta marginación

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Abstract

Access to water in areas of high marginalization is undoubtedly one of the main problems to be solved. The objective of this study was to design two photovoltaic systems with solar pumps, the first to establish a planting area for vegetables, and the second with the purpose of bringing water for livestock consumption. The work was developed during the years 2015 and 2017 in the towns of Vicente Guerrero and Lázaro Cárdenas, municipalities of San Juan de Guadalupe Victoria, Durango, Mexico. In the first municipality there is a pond with a capacity of 50,000 cubic meters and in the second, there is a well. According to the maximum demands of crops 6.6 mm d-1, a pump was designed with a capacity of 221.6 m3 d-1 and a total dynamic load of 25 m with 20 solar panels. In the second case, it consists of moving the water at a distance of 4.5 km and 62 m against the slope, for which a pump with a capacity of 30 m3 d-1 and a total dynamic load of 93.3 m was designed with eight solar panels.

Photovoltaic Systems, Marginal Areas, Agriculture

Resumen

El acceso al agua en zonas de alta marginación, es sin duda, uno de los principales problemas por resolver. El objetivo del presente estudio, fue diseñar dos sistemas fotovoltaicos con bombas solares, el primero para establecer una superficie de siembra de hortalizas, y el segundo con propósito de llevar agua para el consumo de ganado. Los trabajos se desarrollaron durante los años 2015 y 2017 en los pueblos de Vicente Guerrero y Lázaro Cárdenas, municipios de San Juan de Guadalupe Victoria, Durango, México. En el primer municipio se cuenta con un estanque de capacidad de 50 000 metros cúbicos y en el segundo, se dispone de un pozo. De acuerdo a las demandas máximas de los cultivos 6.6 mm d^{-1}, se diseñó una bomba con capacidad de 221.6 m^3 d^{-1} y una carga total dinámica de 25 m con 20 paneles solares. En el segundo caso, consiste en trasladar el agua a una distancia de 4.5 km y 62 m contra pendiente, para lo cual se diseñó una bomba con capacidad de 30 m^3 d^{-1} y una carga total dinámica de 93.3 m con ocho paneles solares.

Sistemas fotovoltaicos, Zonas Marginadas, Agricultura

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Introduction

Addressing the negative effects caused to the environment by climate change, generated mainly by the indiscriminate use of fossil energy sources, is one of the main objectives that concern us today.

The generation and use of cleaner and more sustainable energy sources must be present in production systems. Photovoltaic energy is the process of directly converting energy from the sun into electricity, through the use of solar cells (Pérez and Maldonado, 2013). This, compared to the rest of renewable sources of energy, has among its most important advantages, the most accessible way of providing energy to billions of people without electricity in the world.

The production of photovoltaic energy, through the manufacture of solar panels, increased exponentially during the last fifteen years and it is expected that this trend will continue. Japan is the leading country, and Germany is at the forefront in the European Union. Both countries have based their growth on an adequate balance of research and development programs, associated with a successful fiscal policy that encourages the use of energy from renewable sources. (Hernández, 2007).

In Latin America, Brazil, Mexico and Chile have been the main countries with the highest investments in renewable energy, in which new investments in wind and solar energy stand out. In sectors that demand energy, the use of solar energy represents a great opportunity for reducing costs and carbon emissions into the atmosphere. The use of an emerging solar energy market in Mexico implies efforts to agree on national industrial development strategies and adoptions of new technologies (Ministry of Economy, 2017).

Currently, there are about 1.6 billion people who do not have access to electricity and the areas of the world with less access coincide with those regions of greatest poverty. The lack of electricity affects mainly the rural areas, where most of the people live in extreme poverty; 80% of people without access to electricity live in rural areas (Izquierdo and Eisman 2008; Sarmiento et al., 2017).

In Mexico, by 2010 the population was 112 336 538 inhabitants, of which 48 090 546 live in places of high to very high marginalization rate and two million inhabitants lack housing with electric power (CONAPO, 2010).

In these places, there are potential areas where new technologies can be incorporated to bolster better socio-economic development. Agriculture and livestock are common activities in rural areas. However, one of the main causes that limit their development is the lack of electricity.

In the state of Durango, Mexico, are located the communities of Vicente Guerrero (Siete Zacates) and Lázaro Cardenas (El Zacate). Both communities are considered with a high marginalization rate. In the former, a pond with a storage capacity of 50,000 m^3 of water was built. Runoff caused by rainfall has sustained the volume of water in the pond greater than 50% of its capacity.

Therefore, the need to incorporate a surface to agriculture was raised, where vegetables and legumes can be grown, which would favor the diet of the inhabitants.

Given the lack of electricity, the objective was the incorporation of an area of six hectares for agriculture, with a photovoltaic pumping system and a high efficiency irrigation system in the application and distribution of water, such as the system of drip irrigation with belt.

The Zacate community presented the problem of supplying water for livestock consumption during the dry season.

Livestock feeds mainly of pastures in the upper parts (mountains) that border the Ejido. Livestock consists of bovines and goats, which, during dry season, must travel four to five kilometers to access the river water and, in extreme weather, the mortality due to water limitation can occur.

Here, the objective was to bring water from a well located on the banks of the river and store it in Australian-type ponds with a photovoltaic pumping system and a buried pipe system, with a distance of four and a half kilometers and a counterslope of 62 m high.

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Methodology to develop

Site location for the Siete Zacates case study

The community of Siete Zacates is located between the coordinates 102.62º of East longitude and 24.54 of North latitude, the climate of the region according to the classification of Köpen modified by (García, 1973) is semi-arid dry (BSk) with annual rainfall of less than 600 mm and its average temperature is 19ºC.

Water is available from a pond or pot of water with a capacity of 50 000 m^3, it is fed by surface currents derived from upstream precipitation and converging.

The agricultural area to be established is six hectares, with the purpose of planting crops in the Spring-Summer and Autumn-Winter cycles. In a first stage, two hectares were established, and the crops of tomato, pepper, pumpkin, cucumber and melon were sown, these were transplanted during the Spring-Summer 2015 agricultural cycle. A cyclonic mesh was installed in the perimeter of the surface, with the objective of avoiding the introduction of rodents to avoid damage to the crop. The irrigation system used was drip irrigation with "belt", it consists of six irrigation sections, three-inch main pipe, filters and a venturi fertilizer injector. The irrigation tape was an expense of five liters per linear meter.

Water demands of crops

Water demands for the crops are related to the concept of evapotranspiration. This is an important element in order to estimate water demands and improve water productivity (López et al., 2015). Evapotranspiration is made up of water that evaporates from the soil surface and water that the plant transpires to carry out photosynthetic processes.

The concept of evapotranspiration of the reference crop (ETo) was introduced to study the demand for evapotranspiration of the atmosphere, regardless of the type and development of the crop, and management practices; to estimate this demand, the "A" class evapoporimeter tank method (FAO Irrigation and Drainage Study 56, 1990) was used. The equation is expressed as:

$$ET= kp\ Ev \quad (1)$$

Where (kp) is a coefficient of the tank, which depends on the conditions that surround it and (Ev) is the daily evaporation that occurs and is expressed in mm d^{-1}. For the design of the irrigation system, the term maximum evaporation (ETo_{max}), also known as design evapotranspiration, was used; maximum evapotranspiration occurs during maximum crop development and generally takes place during the months with the highest solar incidence.

It is an essential indicator in the water balance available for irrigation programming (Prasanna, et al., 2008). The maximum daily volume (V_{max}) was calculated as:

$$V_{max}=[(ETo_{max}S) / Ea]\ F \quad (2)$$

Where (S) is the surface to be irrigated or incorporated into irrigation, (Ea) is the efficiency of water application, which depends on the method of irrigation to be used and (F) is the fraction of the surface to be irrigated, which depends of the crop (Boswell, 1990). In the design of the project, a drip irrigation system was used, these systems have an application efficiency of 90%.

Calculation of peak solar hours and pump expense

In a photovoltaic system, the pump operates according to peak solar hours (Thsp) which depends on the intensity of the incident radiation kW-h m^{-2} d^{-1} and divide it by the Standard Test Condition (STC) which is 1000 kW-h m^{-2} d^{-1} of radiation and cell temperature of 25ºC (Solar Energy International, 2007). Thus, the pump's operating time or peak solar hours are determined by the equation:

$$Thsp = \text{Incident radiation kW-h } m^{-2}\ d^{-1}/1000\ \text{kW-h}m^{-2}d^{-1} \quad (3)$$

The pump expense was calculated with the ratio:

$$Q=V_{max}/Thsp \quad (4)$$

Total dynamic load of the pump

The total dynamic load (H) is the sum of friction losses (h_f) plus the operating pressure of the irrigation system (h_{op}) required by the last section of the irrigation system, that is, the section farthest from the pumping source. The operating pressure of the system is specified by the manufacturer of the irrigation system.

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$$H = hf + h_{op} \quad (5)$$

Friction losses were calculated using the Hazen Williams equation cited by (Vegas et al., 2018) and expressed as:

$$hf = 10.674 \ L \ D^{-4.87} \ (Q_t/C_{HW})^{1.852} \quad (6)$$

Where: (L) is the length of the pipe in m, (D) is the diameter of the pipe in m, (Q_t) is the expense of the pipe in m^3 sec^{-1} and (C_{HW}) is the Hazen Williams coefficient which depends on the type of material the pipe is made of. One of the reasons for using this formula is for mathematical simplicity and direct solution (Provenzano et al., 2007).

Pump capacity and number of panels

The capacity of the pump is determined by equation (7) where: (B_{HP}) is the power of the pump in horsepower, Q is the expense (m^3 sec^{-1}), (γ) is the specific weight of water kgf m^{-3}, total dynamic load (m), ($\mathcal{E}$) is the efficiency of the pump and 75 is the conversion factor, i.e. a horsepower is equal to 75 kgf-m s^{-1} (Moreno et al., 2018). A factor of 1.3 is recommended to apply to the power of the pump (Uzquiano et al., 2015). The horsepower of the pump was converted to watt, that is, a B_{HP} is equal to 745.7 watt.

$$B_{HP} = [(Q \ \gamma \ H)/ (75 \ \mathcal{E})] \ 1.3 \quad (7)$$

The number of panels (NP) was calculated by dividing the power of the pump, by the power of a single panel (P_p), multiplied by the efficiency (η) of the panels. Its value ranges from 0.85 to 0.9 (Alonso, 2019).

$$NP = B_{HP}/(P_p \ \eta) \quad (8)$$

Location of the site for the case study El Zacate

El Zacate is located between the coordinates 102.84º of East longitude and 24.72 of North latitude, the climate of the region according to the classification of Köpen modified by (García, 1973) is semi-arid dry (BSk) with rainfall less than 600 mm annually and average temperature of 19ºC. The ejido is located next to the Agua Naval River, which channels the rainfall that occurs between the states of Zacatecas and Durango.

The source of water supply is a well or wheel with a depth of twelve meters. This is fed by water that is filtered from the river, and according to pumping tests performed, the well can sustain an expense of six L s^{-1}.

Water demand for cattle

Water demand for livestock consumption were previously consulted with the ejido authorities and local farmers. It was based on the fact that an adult bovine consumes water between 8 and 10% of its weight.

A dairy cow can consume between 38 and 110 liters of water per day, a beef cattle from 26 to 70 L d^{-1} and a sheep from 4 to 15 L d^{-1}. Pregnant females consume more water and lactanting ones consume more than dry ones (Duarte, 2019). Thus, the daily volume (V_d) was estimated with equation (9), where (Nc) is the number of head of cattle and (CPP) is the average daily water consumption per capita.

$$V_d = Nc \ \ CPP \quad (9)$$

Calculation of peak solar hours and pump expense

The pumping time was calculated with equation (3) and the pump cost with equation (10), where Vd is the daily volume demanded by cattle, which depends on the number of heads and water consumption per capita.

$$Q = V_d/Thsp \quad (10)$$

Total dynamic load

The total dynamic load was obtained with equation (11), where (ΔZ) is the difference between the point where the water is to be pumped, to the point where it is to be carried. The negative sign means a slope in favor and the positive sign a slope against the circulation of water. Friction losses were calculated with equation (4)

$$H = hf \pm \Delta Z \quad (11)$$

Pump capacity and number of panels

Pump capacity was estimated with equation (7) and the number of panels with equation (8).

Results for the case study of Siete Zacates.

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Water demands of crops

Maximum evapotranspiration was estimated with equation (1); according to (Irrigation and Drainage Study FAO 56, 1990) the tank coefficient was 0.7 and studies carried out by (Montemayor et al., 2012) indicate that, for the climatic zone, there is a maximum evaporation average value of the tank of 9.5 mm d^{-1}. Therefore, the Eto_{max} calculated was 6.6 mm d^{-1}. Eto_{max} = 0.7 x 9.5 mm d^{-1} = 6.6 mm d^{-1}

This value coincides with those reported by (Irrigation and Drainage Studies FAO 26, 1990; García, 1973) for climatic zones with extreme temperatures, greater than 30ºC. The maximum daily volume was obtained with equation (2). Thus, for an area of six hectares or 60,000 m^2, the volume of 221.6 m^3 $d^{-1}$was obtained.

V_{max} = [(0.00665 m d^{-1} 60 000 m^2) /0.9)]0.5 = 221.6 m^3 d^{-1}.

This value of 221.6 m^3 d^{-1}, represents the maximum demand for water that can occur for a given day, usually it takes place when the crops are in maximum development and temperatures are at their highest.

Calculation of peak solar hours and pump expense

According to the location of the project with a longitude of 102.62º N and a latitude 24. 72º E, six to nine kW- h m^2 d^{-1} are received, with the months of April to October being the ones with the highest radiation (NASA Prediction of Worldwide Energy Resources, 2019).

The peak solar hours obtained according to equation (3) were six hours of minimum operation and nine hours of maximum operation of the photovoltaic system. To calculate the pump cost, the minimum operating time was considered. Thus, according to equation (4), the pump expense was:

Q= 221.6 m^3/6 h = 36.93 m^3 h^{-1} = 0.01 m^3 s^{-1}.

Total dynamic load of the pump

The total dynamic load is the sum of friction losses and the operating pressure that the irrigation system requires.

In a belt irrigation system, a ten meter h_{op} water column (mca) is recommended by the manufacturer; friction losses were calculated with equation (6), the length of the pipe was 350 m, which is the distance from the pump to the farthest irrigation section, the internal diameter of the pipe is 0.08 m, the Pipeline expense is 0.01 m^3 s^{-1} and C_{HW} is 150 for polyvinyl chloride (PVC) pipes.

$hf = 10.674\ 350m\ (0.08m)^{-4.871}\ (0.01/150)^{1.852}$ =15.14 mca

Thus, friction losses were 15.14 mca. The total dynamic load of the pump is given by equation (7) which gives us a total dynamic load of 25.14 mca.

H = 10 mca +15.14 mca = 25.14 mca.

Pump capacity and number of panels

With the total dynamic load and water demand by the system, the pump power is calculated using equation (5). B_{HP}= [(0.01m^3 s^{-1} 1000 kg m^{-3} 25 m)/ (750.75)] 1.3 =5.7 H.P = 4,250.4 watt

Thus, for a total dynamic load of 25 mca and an expense of 0.01 m^3 sec^{-1} considering a pump efficiency of 0.75, we calculated for a pump motor power that resulted in 5.7 H. P and equal to 4 250.4 watt.

Number of panels

The number of panels was calculated with equation (8), where:

NP= [4 250.4 watt / (250 watt 0.85)] = 20 panels

The twenty panels were connected in series and oriented to the south, with an inclination angle of 25º; an inclination equivalent to latitude is recommended by (Palacios y Morales 2017). The panels were connected to an inverter with a capacity of five kW- h m^2 d^{-1} and the AC outputs were connected to the pump.

Results for the case study of El Zacate.

Water demand for cattle

The daily volume of water was calculated with equation (9), an average per capita consumption (CPP) of 50 L day^{-1} was obtained.

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To size our daily demands, we considered a cattle herd of 600 heads. Thus, the daily volume was 36,000 liters per day.

V_d= 600 * 50 L d^{-1} = 30,000 L d^{-1} =30 m^3 d^{-1}

Calculation of peak solar hours and pump expense

Peak solar hours or operating time of the photovoltaic system were calculated with equation (3). According to the location of the 102.84º East longitude and 24.72 North latitude, were received at least 5.75 kW-h m^{-2} d^{-1} to 9. kW-h m^{-2} d^{-1} (NASA Prediction of Worldwide Energy Resources, 2019). The above indicates that the system can operate from 5.75 hr to 9.75 h. A minimum time of six was considered for the operation of the system. The pump expense was calculated with equation (6), where an expense of five m^3 hr^{-1} was obtained. Although, as mentioned above, the operating time of the pump can be up to nine hours. Therefore, the pumped volume can be much higher.

Q = 30 m^3 d^{-1}/ 6 h d^{-1} = 5 m^3 h^{-1}.

Total dynamic load

Friction losses were calculated with equation (7) with a pipe length of 4500 m; the pipe diameter was two inches, the expense of 0.001 m^3 sec^{-1} and C_{HW} of 140

$hf = 10.674\ 4500m\ (0.05m)^{-4.871}\ (0.001m^3\ s^{-1}/140)^{1.852}$ =31.3 mca

The total dynamic load was calculated with equation (11), where the unevenness of the water mirror where the pumping source is located to the point where the Australian tanks were located was 62 meters. Thus, the total dynamic load was 93.3 mca.

H = 31.3 + 62 = 93.3 mca.

Pump selection and number of panels

The power of the pump was calculated with equation (5), for which an expense of 0.001 m^3 s^{-1} and the total dynamic load of 93.3 mca was considered.

B_{HP}= [(0.001m^3s^{-1} 1000 kg m^{-3} 93.3 m)/ (75 0.75)] 1.3 =2.15 H.P = 1 603.2 watt

The number of panels was calculated with equation (8), where the power of a single panel is 260 watt. Thus, we have:

NP= [1,603.2watt / (260 watt 0.85)] = 7.27 panels

Eight panels were connected in series and oriented to the south with an inclination angle of 25º. The panels were connected to an inverter with a capacity of five kW-h m^2 d^{-1} and subsequently the AC outputs were connected to the pump. The installed pump was with a maximum capacity of 5 m^3 h^{-1} and a maximum load of 145 mca.

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Conclusions

In the case of Siete Zacates, the solar pump has worked normally and vegetables such as tomatoes, peppers, squash, garlic, onion and others have been produced. This has contributed to improve the diet of the residents of the community and the products are being marketed. In the case of the El Zacate study, there were no problems in the operation of the equipment and the effects of the dry season regarding animal mortality due to water limitations have been reduced.

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Traditional management of Agave used for mezcal and its associated knowledge: the case of Oaxaca and Aguascalientes, México

Manejo tradicional de los Agaves mezcaleros y su conocimiento asociado: el caso de Oaxaca y Aguascalientes, México.

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Abstract

Maybe the most known and diffused use of the Agave genus plants is the production of alcoholic beverages, being mezcal and tequila the most consumed. As a matter of fact, increased demand for these beverages has led to important pressures in the ecosystems from which the Agave is obtained. In the present article, we compare management practices carried out by mezcal producers in Oaxaca and Aguascalientes, comparing the state that produces the most volume of mezcal with a state that is new to that industry. We define management as "the interventions, transformations or decisions over natural or artificial systems, their elements and functional processes with explicit purposes", according with Casas et al (2014). We also explore the expressions of management, as ways to take advantage, preserve, restore or take back the vegetable elements of the ecosystem and the agroecosystem, finding important differences in terms of future sustainability for the alcoholic beverage industry.

Agave, Management, Cultivation

Resumen

Quizás el uso más conocido y difundido actualmente de los agaves es la producción de bebidas alcohólicas, siendo el tequila y el mezcal las más consumidas. De hecho, el incremento a nivel nacional y mundial de estas dos bebidas ha generado presiones importantes en los ecosistemas de los que se extrae el agave como materia prima, tanto para su uso directo, como para la obtención de semillas o plántulas. En el presente artículo, comparo las prácticas de manejo que llevan a cabo productores de mezcal en Oaxaca y Aguascalientes, contrastando al estado de mayor producción de la bebida, en donde existen incluso problemas para el abastecimiento de la planta, con un estado cuya producción de la bebida y aprovechamiento magueyero con tales fines, es incipiente. Defino como manejo a "las intervenciones, transformaciones o decisiones sobre los sistemas naturales o artificiales, sus elementos y procesos funcionales con fines explícitos" de acuerdo con Casas et al. (2014). Siguiendo a estos mismos autores, se exploran las expresiones de manejo del recurso agave, entendiendo a éstas como las formas de aprovechamiento, conservación, restauración o recuperación de los elementos vegetales de un ecosistema o agroecosistema, encontrando importantes diferencias en términos de sustentabilidad.

Agave, Manejo, Cultivo

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Introduction

Mexico is the point of origin and diversification of the genus *Agave*, belonging to the family *Agavaceae* or *Asparagaceae*, constituted, in national territory, by 159 species, of which 123 are endemic, being the eighth most diverse of the Mexican flora (García, 2007; García, Franco and Sandoval, 2019).

Agaves, or *magueyes*, are predominantly found in arid or semi-arid areas of the national territory, from 34° north latitude to 60° south latitude, being more abundant in the south of the republic, mainly in southern Puebla and northern Oaxaca (García, 2007), in terms of diversity of species and abundance of individuals.

The genetic diversification of the agaves is wide, since it is a species highly adaptable to different environmental conditions and, in addition, the management made by human populations of these plants, due to their socio-cultural importance, has contributed to the generation of varieties and cultivars (Lara-Ávila and Alpuche-Solís, 2016). Its use to obtain fibers, food and beverages, as well as agricultural uses aimed at retaining soils on steep slopes, has been widely documented (Castro and Guerrero, 2013; Félix-Valdez et al., 2016). The multiple uses of the species throughout the national territory have derived in an important knowledge about the growth cycle of each plant and its reproductive particularities, whether sexual or vegetative (Bautista and Smit, 2012). Depending on the species, Agaves can be propagated by seed, by vegetative stems, by propagules in inflorescence or by these three forms (Andrade and Martínez, 2017). Commonly, the separation of offshoots into nurseries or to the definitive growing ground is used directly. This is the fastest way to have an adult plant, since it avoids the risks of germination and the early stages of development (Félix-Valdéz, Vargas-Ponce, Cabrera-Toledo, Casas, Cibrian-Jaramillo and Cruz-Larios, 2016; Andrade y Martínez, 2017).

Perhaps the best known and widespread use of agaves today is the production of alcoholic beverages, with tequila and mezcal being the most consumed. In fact, the increased demand at national and global level of these two beverages has generated significant pressures in the ecosystems from which the Agave is extracted as raw material, both for direct use, and for the obtention of seeds or seedlings.

The Mezcal Regulatory Council reports that in 2016, the certified production of this beverage, that is, that with a guaranteed replacement of the plant, was 3 million liters, while the non-certified was greater than 6 million liters, generating significant pressures on plant populations and their ecosystem (CRM, 2016). On the other hand, García, Méndez and Talavera (2010) report that 18 species are now endangered, because they are extracted from their natural environment, which represents a threat to their habitat, since they are indispensable for the proliferation of pollinators such as bats.

In this paper, we compare the management practices carried out by mezcal producers in Oaxaca and Aguascalientes, contrasting the state that is the greatest producer of the beverage, where there are even supply problems due to constant shortage of the plant, with a state whose production and use of the agave for such purposes is recent. We define as management the "interventions, transformations or decisions about natural or artificial systems, their functional elements and processes for explicit purposes," according to Casas et al. (2014). Following these authors, we explore the expressions of management of the agave resource, understanding these as the forms of use, conservation, restoration or recovery of the plant elements of an ecosystem or agroecosystem (Casas, et al. 2014) to obtain the same resources for human activity. Contextual elements are presented in the background, methodology and results classified by management categories.

Background

Unlike the tequila that is produced in Jalisco from a single species of Agave (*A. tequilana Weber*), mezcal is characterized by a great diversity of *magueyes* that can be used for its elaboration.

Some authors mention 53 species (Colunga-García Marín and Zizumbo-Villarreal, 2007; Torres, Casas, Delgado-Lemus and Rangel-Landa, 2015) but, regardless of certainty in numbers, the highest proportion of plants used to prepare mezcal, both in Oaxaca and Aguascalientes, are wild and are extracted -also in most cases- without proper planning to ensure the future conservation of wild populations through sexual reproduction.

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Since the Agave is harvested just before flowering, when all carbohydrates are concentrated in the stem to start the reproductive stage (Delgado-Lemus, Casas and Tellez, 2014), which prevents the formation of flowers, fruits and subsequently seeds.

The agave used in Oaxaca to produce mezcal is *A. angustifolia* known locally as *maguey espadín*, this species gives rise to basal offshoot and propagules in the floral escape after cutting the apex, which facilitates *maguey* producers vegetative propagation, with a maturation period of five to six years for harvest, one of the shortest periods for maturation in *magueyes*. However, not all *magueyes* in Oaxaca have the ability to reproduce vegetatively and require flowering for seed production, as is the case with *A. marmorata*, used to prepare the tecaltate mezcal, which takes up to 25 years to mature (García, 2007), or *A. potatorum*, known as *papalometl* or *tobalá*. Agave maturation times are an important reason for mezcal producers to choose to remove the plant from the wild, instead of planting it on their land, either for family processing of mezcal, or to sell the plant to companies that produce the drink industrially, which offers them short-term gains, but it accentuates a problem of plant shortage in the medium and long term.

In Aguascalientes, the *Agave salmiana* is predominant, although *Agave angustifolia* var. *Samandoki*, native of the deciduous lowland forest, was disseminated by a Strategic Forestry for the State of Aguascalientes 2030 of CONAFOR for its ability to prevent soil erosion on steep slopes. Both have the possibility of spreading vegetatively. In Oaxaca, a state that produces 92% of the national total of mezcal (CRM, 2018), given the constant shortages of agave experienced annually and the growing demand, strategies to ensure availability of some species for the elaboration of mezcal are increasingly observed by producers, families, organizations and companies. In the state of Aguascalientes, with an approximate production of 1.15% of the national total of mezcal (personal communication from *maguey* producer), Agave is also used for its agronomic functions and for the elaboration of other products such as syrup and, despite that in the state a shortage of *maguey* cannot be foreseen in a short term, it is relevant to understand the management that is part of the *Agavero* landscape in times of population stability.

Understanding the management practices carried out by human populations that make use of significant amounts of plant (approximately 15 kilograms of *maguey* per final liter of mezcal) is important to recover the traditional knowledge of the region, as well as elucidate the future of the mezcal landscape in Mexico. So, this work aimed to document the management practices carried out by mezcal producers in Oaxaca, the main producer of the beverage nationalwide, and in Aguascalientes, a state that only recently (2018) obtained the denomination of origin as producer state.

Methods

Field work was carried out during the months of July-November 2017. During this period, field research activities were conducted in the producing areas of mezcal Agave in Oaxaca (San Juan del Río and San Luis Amatlán) and Aguascalientes (Terrero de la labor).

In San Juan del Río, district of Tlacolula, region of Valle Centrales of Oaxaca, semi-structured interviews were applied (Díaz-Bravo, Torruco, Martínez and Varela, 2013) with seven mezcal producers who produce or extract the plant, while field trips (seven) were carried out for recognizing the routes and obtaining *magueyes* from each producer. During each tour, guiding questions were applied on practices related to the assurance of Agave's presence (or absence thereof).

In San Luis Amatlán, district of Miahuatlán, Sierra Sur region, Oaxaca, we worked with a group of eight *maguey* producers, with the focus group methodology and semi-structured interviews (Escobar and Bonilla, 2009) prior to field visits, as well as participatory mapping (Sletto et al., 2013) of the territory and its agaves. In this town, a three-kilometer route was made with participant observation with each of the five producers. During the collective activities, a survey was conducted on management practices used in agroecosystems as well as in the wild, to ensure the availability of Agave plants. With the information from the survey, the interviews and the participatory mapping, information was obtained on the main problems related to the wild and controlled reproduction of Agave plants, the management ways to guarantee their availability, as well as a mapping of geographic areas with abundance and shortage by species.

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In Aguascalientes, we visited a polygon of 26 hectares of common use in the El Terrero de la Labor ejido, municipality of Calvillo. During the tour, conducted with five ejidatarios, the ejido commissioner and the president of the Agave-mezcal Product System of the state, who commented on management practices and questions of the semi-structured survey applied in Oaxaca.

The information obtained was poured into an Excel database to generate categories by management strategies mentioned, by location and state.

The management forms and practices were separated into categories based on the elements mentioned by producers and on the literature of Casas et al. (2007 and 2014). From this analysis, the results for both states are presented.

Results

Some of the actions for extracting *maguey*, including rhizome cutting, discarding the phenotypes considered less appropriate or encouraging those of greater size and shape, are *in situ* management actions (Casas, Otero-Arnaiz, Pérez-Negrón and Valiente-Banuet, 2007; Blancas et al., 2010), which involve artificial selection practices that change, in the landscape, the proportion of phenotypes and species in ecosystems, such as incipient domestication processes (Colunga-Garcíamarín and Zizumbo-Villareal, 2007).

The cutting of offshoots and sometimes the selection of the "best" agaves (defined by criteria of size and thickness of the stem) to allow the obtention of seed, with the purpose of sexual reproduction in greenhouses, tend to modify the agave landscape, reducing the genetic diversity of the populations and the populations themselves in a physical and ecological way (Parker et al., 2010; Torres, Casas, Vega, Martínez-Ramos and Delgado-Lemus, 2014).

Therefore, this modifies the configuration of mezcales available, in sensory terms. In this sense, sexual reproduction predominates in wild populations, while vegetative propagation is the most common in those subjected to cultivation or some form of management.

Other authors have reported that some management strategies, such as the introduction of varieties from different regions, or the establishment of diversified nurseries, achieve significant levels of genetic diversity, even greater than in wild populations, by promoting cross-pollination between cultivars and varieties (Brush et al., 195, Pujol et al., 2005, Casas et al., 2007 and Vargas-Ponce et al., 2009).

These strategies combine varieties that in the wild do not reproduce or grow in the appropriate distances for pollination and can lead to gender diversification, that is, greater population genetic diversity but reduced in terms of species.

Forms of management and expressions of exploitation of Agaves in Oaxaca and Aguascalientes

We define as "management" the interventions, transformations or decisions on natural or artificial systems, their elements -or resources- and functional processes -or ecosystem services- for explicit purposes (Casas, et al. 2014). Management can adopt multiple expressions, such as forms of exploitation, conservation and restoration or recovery.

The information obtained allows the separation of management practices between those that are carried out in an uncontrolled natural environment and those conducted in planned or controlled environments in terms of environmental variables, such as nurseries, pieces of ground for cultivation or backyards.

We separate the analysis of management practices into two categories, according to the environment in which they are carried out, in accordance with the proposal of Casas et al. (2007) and Figueredo et al. (2015), as *ex-situ* (controlled sites in which the plant resource is extracted from its natural environment) and *in-situ* (management practices carried out in wild environment).

In this paper we do not intend to analyze the levels of domestication of populations, since agaves are distributed in a continuum of wild or uncontrolled environments to habitats planned and managed by human populations.

Understanding degrees of domestication usually involves comparative genetic analysis.

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We are concerned with the difference between cultivated plants with total control of their phenological stages and their requirements to obtain the desired parts in the best possible state for human purposes and the polarity with wild plants, such as those that grow in environments without control of variables, understanding, with Harlan (1992), that to any degree of management of plants or the environment, there are ecological adaptations, usually associated with morphological differences that include intermediate states. According to this, it is possible to grow wild plants without them being, necessarily, domesticated.

In Oaxaca, but also in Aguascalientes, it is observed that wild plants are taken to gardens, nurseries or backyards and later returned to their natural environment, promoting a constant movement of the plants. In Aguascalientes, some forms of natural resource management were identified, such as the integration of mixed systems.

The areas of common use were distributed and assigned to the ejidatarios that make up the agrarian nucleus. Each of them used barbed wire fences to limit their assigned space. Each of these spaces is considered as "Productive Unit (PU)", with agroforestry systems with agaves, some wood for domestic use (bioenergetic), corn and grazing (cattle and goats).

The ejidatarios have varied the activities in their PU, so that their agricultural work generates a diversification of income. As a result, it has been observed that during an agricultural cycle, the activities are constant; taking care of the preparations of crops such as corn and *maguey*, while grazing goats or cattle, as well as the permanent extraction of firewood. In all these complex agricultural management systems, we distinguish the following common practices:

In-situ practices

Protection

It consists, as the name implies, in protecting seedlings in early stages of development, or *magueyes* that are considered exemplary or perfect to provide offspring and seedlings.

The possibility of protecting either seedlings in a wild or reforested area or adult specimens from being picked and subsequently harvested by another person to obtain seeds, rests in the form of land tenure where the ground is located. If it is a land owned by a private owner (either small property or own ejido portion), the possibility of achieving plant growth or protecting the specimen is greater than when it comes to community land, to which people introduce goat or cattle for grazing, or some mezcal producer chooses the adult maguey for their factory.

Normally, grazing is an activity that crosses the land of an owner, so that the protection of seedlings to be effective even on individual land, involves the enclosure of the land or even the posting of notices to inform neighbors or shepherds that it is an area with young plants that must be protected. However, in San Juan del Río, Oaxaca, the growing opening of cultivation areas for *maguey* in the last 3 years (2015-2016 to date) has implied community agreements not to cross individual lands and stick to common areas. This has implied a decrease in the use of communal ejido areas for reforestation and an expansion in the individual extensions of the producers. Although there were agreements for the use of *maguey* in communal areas, these have now lost their validity.

Palma (2000) reports protection of specimens of *A. Kerchovei* and *A. americana*, which grow isolated (not in colonies), by sprinkling their leaf apices with water and manure, to protect livestock intake. This practice was corroborated in Miahuatlán, although it is not assumed effective for young specimens. In the case of Aguascalientes, no protection practices have been identified.

Collection

It could also be called "assisted regeneration actions." It is not a proper management practice, but it is the most common way of obtaining the slowest-growing varieties through the collection and relocation of bulbs, either at the base of the agaves or in the floral escape, towards land of planting or in environments with a certain degree of protection to ensure the survival of the plants. Often, the plants are stacked in the yard of the houses, with periodic watering, to subsequently be transplanted in the rainy season.

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At the time of planting, the tips of the *magueyes* are cut to stress them and encourage roots and development. In Oaxaca, the collection for young offshoots of *A. marmorata, A. americana* and *A. karwinskii* is practiced in terms of uncultivated *magueyes*. However, seed collection is also carried out for all *magueyes*, which germinate in seedlings for a year and a half or two, prior to transplantation. The collection of seeds depends on the protection of mature agaves to achieve the maturation of the floral escape in specimens that are selected in owned property by their size, with the aim of conserving their genetic potential for later planting. For subsequent sowing of the seeds, those with whitish coloration are discarded, carrying out a selection process.

In Aguascalientes, the collection is conducted in Calvillo, Tepezalá and Real de Asientos, where the seeds are harvested mainly from the *Agave angustifolia*, *A. salmiana* and *A. Americana*. They are stored in the courtyards of the ejidatarios and put to germination in seedlings, to be later transferred to the closest grounds of the ejidatarios. In the case of Tepezalá and Asientos, the Agave producers are organized around the Product System and the Association of Mezcal Women A.C., so they have been beneficiaries of the State Government's Productive Reconversion program for the planting of agaves. This activity has allowed the establishment of various plantations, vegetative material is granted to each of the beneficiaries, so seed collection is practically nil.

Tolerance

Tolerance is a practice that consists of conserving specimens of a plant species, the growth of which is not the final aim of a producer, in a predominantly agricultural space. Prior to the rise of mezcal and extensive agave cultivation, some seedlings were allowed to proliferate on agricultural land or adjacent to homes in urban areas; however, given the increased use of Agave for the elaboration of mezcal, the practice of tolerance does not apply, as it is currently promoted and protected; it is no longer seen as a species that is "allowed" to continue regardless of its usefulness.

In the Aguascalientes environment, it has been observed that this practice is scarce. Only some specimens have been left for seed and mostly as ornaments for landscape purposes.

Especially in the spaces where distillation workshops will be set up with small businesses selling food.

Induction

This practice includes strategies aimed at increasing the diversity of populations of useful species in a plant community (Casas et al., 2007).

It includes the burning of vegetation that favors the proliferation of some species or the planting of vegetative propagules of plants in wild areas. In Oaxaca, burning is not induced for the growth of *maguey*, however, producers are aware that when a property catches fire, the agave tends to mature faster "although with less flavor" (Hermogenes, producer of *maguey* and mezcal, 52 years, Amatlán, Oaxaca).

The reforestation in communal areas of propagules of wild agaves in Oaxaca takes place mainly in communal lands in San Juan del Río, mainly from the areas visited; however, due to the indiscriminate extraction of *maguey* in the last five years and the proliferation of plantations in owned properties it has decreased drastically.

Induction in Oaxaca is also carried out by irrigating seed or transplanting young plants of *A. potatorum* in rocky wild areas.

In the case of Tepezalá, Aguascalientes, there are agreements between the ejidatarios to conduct reforestation, through propagules, in the common areas, planting three agaves for each one that is extracted to obtain mead for pulque.

Ex-situ practices

It refers to the plantation or use of a species for commercial purposes. In the two municipalities of Oaxaca, this practice is the most common due to the increase in the demand for mezcal, displacing native vegetation (low forest) to land that is increasingly sold or rented to ejidatarios or community members and which were previously used for sowing cornfields or were in agricultural disuse.

The agave under agricultural management practices, although it is diversified in terms of supply and forms of management to incentivize productivity, is observed in two broad systems:

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Monocultures

They are agricultural spaces in which a particular species is grown, either for commercial or subsistence purposes. It also seeks to prevent the growth of different plants such as temporary herbaceous.

In both San Juan del Río and San Luis Amatlán, the plantations of *A. angustifolia or maguey espadín* are becoming more common, both on flat terrain and on hillsides. The comuneros constantly acquire more land for the cultivation of this species of *maguey*, which is the fastest-growing species (5-6 years), and from which vegetative propagules are consistently obtained.

In San Luis Amatlán it is customary to plant wild agaves, such as *A. marmorata* or *A. karwinskii* on the boundaries of the *maguey espadín* plantations, or insert *maguey espadín* with *A. americana* (arroqueño) or *A. potatorum* (tobalá); the latter only in the case of rocky terrain. In San Juan del Río this practice is uncommon, as extensive crops of *A. angustifolia* predominate, however some owners cultivate *A. americana* in 2.0X2.5 grooves.

In Aguascalientes, producers started hastily their *maguey* plantations because the vegetative material was delivered by the National Forestry Commission without prior training in mid-2018. In this first stage, they were established under a monoculture model. Only the *Agave salmiana* was planted.

Polyculture

It is characterized by the cultivation of more than one plant species in the same agricultural space. In Oaxaca, both in San Luis Amatlán and in San Juan del Río, families have an average land of 3 hectares, in which the common sowing density of 1.50X2, 2X2 or 2.50X2 allows only 2000 to 3000 plants of *A. angustifolia* per hectare on land that can be shared, for the first three years, with the sowing of *milpa* (corn-bean system).

The growth of the Agave leaves subsequently hinders the planting and harvesting of other products from the third year, so the land is dedicated exclusively to the *maguey*, which, when extracted, generates a single gain until the next harvest cycle (3 to 4 years later).

In Amatlán, people manage stepped plantations. They are carried out in rows of agaves with different ages: plants of eight, six and two years. In the rainy season (May-October), beans, *milpa* and corn are interspersed. Also, the planting spaces with *higuerilla* are inserted or surrounded, an energy crop that has arrived in the region since 2016 from the installation of the oil extraction plant in Ejutla, which buys seeds per kilo from the producers.

This does not happen so commonly in San Juan del Río or Sola de Vega, where there is an important presence of mezcal brands. In this municipality, the producers have to decide to sell to brands vs. sell as a cooperative with their own brand. Mezcal brands rent fields in a 50-50 scheme, in which the producers provide the land and the brands send technicians to plant the Agave, mainly *espadín* and to a lesser extent *tobalá*. Since brands supervise and decide the ways of planting, there is no possibility of introducing other crops.

At least 30 producers in San Juan del Río are already working with brands, which invite their families to work in the same scheme: committing a stable amount of mezcal or renting land. Mezcal production by contract is becoming a problem, as producers often cannot meet volumes in established times and are forced to extract wild agaves or buy from other producers to comply and avoid suits.

In Aguascalientes, mezcal production is incipient. The agaves used to produce mezcal in this region are *Agave salmiana* also known as pulquero, *angustifolia*, in a wild variety known locally as "samandoque" or "samandoki," extracted from the natural environment to produce an average of 2500 liters per year. In this region, there is no significant pressure on the ecosystem yet, but its product has the potential to grow in volume and quality over the next few years, given the current international demand for mezcal. In the ejido of the Terrero de la Labor, in the municipality of Calvillo, offshoots and seed of *Agave angustifolia var. Samandoki* were domesticated, which were distributed by the CONAFOR soil conservation program, although there are also *Salmian Agave* plantations for the production of mead and pulque. Agave plantations were implemented on private and ejido lands in order to restore soil and gather rainwater; contours were also made for the same purpose.

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It is worth noting the actions carried out in Puerto de la Concepción, where there is significant progress in the restoration of soil through the sowing of Agaves in contour lines. In this sense, the presence of *Agave salmiana* constitutes the species with the highest population in the entire Aguascalientes territory. At the end of 2018 and the beginning of 2019, prior to the second stage of *maguey* crops, training on topics such as the establishment of agroforestry systems under the agroecological perspective, food systems and sustainable production was provided to communities. Producers from the municipalities of Asientos, Tepezalá, El Llano and Hacienda de Mirandillas undertook the training. After the sessions in Agroecology, agroecological systems were designed from the perspective of the producers, which integrated food crops such as corn, squash, legumes, *maguey* and *nopales*, as well as timber (oaks and mosques). In this second stage of planting, the species of *Agave salmiana* and *A. americana* were used.

Vegetative Propagation

It is the most commonly executed in nurseries, while it is the fastest way to grow a plant. Most agaves spread asexually, producing clones in different parts of the rosette or inflorescence.

The offspring develops at the base of the plant, or emerges by stolons at some distance from the mother plant, producing roots and, over time, growing independently. The intrafoliar offshoots grow between the leaves of the rosette and develop when they detach from the mother plant or it dies. Bulbs, on the other hand, originate in the inflorescence, next to the flowers.

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Conclusions

Recognizing the different agave management systems allows us to understand the strategies with which producers secure the material to supply a growing demand, as the distillate consumption increases worldwide.

The management strategies carried out to obtain agave, the traditional knowledge bases that these strategies entail, as well as the understanding of the consequences of each system, are key to any intervention strategy to be executed.

Likewise, the heritage of biocultural knowledge that underlies management decisions contributes to the identity of ancestral peoples related to the *maguey*, their environment and the different uses given to natural resources.

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Data sheet

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Generation of electric energy using natural water affluent through the design of a pelton turbine prototype

Generación de energía eléctrica usando afluente de agua natural mediante el diseño de un prototipo de turbina

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Abstract

Agriculture in Mexico is an economic activity that allows for the livelihood of the most vulnerable families. However, the economic development of producers is reduced by the energy costs generated at work. For this reason, a prototype of Pelton turbine specially designed to take advantage of the natural fall of water was developed; in this way, clean energy is used for the same agricultural activity. The prototype results in a low-cost solution to reduce energy costs for small Mexican agricultural producers. The prototype is designed for a non-industrial water affluent but natural fall, the prototype was field tested, measuring performance results and having a substantial contribution to possible energy saving.

Turbine, Generation of energy, Clean energy

Resumen

La agricultura en México es una actividad económica que permite llevar el sustento a las familias más vulnerables, sin embargo el desarrollo económico de los productores se ve mermado por los gastos energéticos que se generan en la labor, es por esta razón que se desarrolló un prototipo de turbina Pelton diseñada especialmente para aprovechar la caída de agua natural y así aprovechar la energía que esta caída a través del prototipo puede generar, de esta manera se genera energía limpia que se utiliza en artículos propios para la misma actividad agrícola, el prototipo viene a ser una opción de solución a bajo costo para disminuir gastos energéticos en productores agrícolas pequeños Mexicanos. El prototipo está diseñado para una afluente no industrial de agua sino caída natural, el prototipo fue probado en campo midiendo resultados de rendimiento teniendo una contribución sustancial a un posible ahorro energético.

Turbina, Generación de energía, Energía limpia

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Introduction

Pelton turbines are hydraulic machines capable of generating electrical energy by circular movement of their blades, commonly known as spoons. This movement is generated through a stream of fluid that falls directly into the blades and the force of impact, this means that the pressure with which the fluid leaves the pipe will be the same that moves the blades, which in turn, will move a rotor or shaft attached to a chain or band that will move the generator that, when connected to another instrument, tool or machinery, will be turned on, without the need of household electric current or provided by the Federal Electricity Commission. Thus, the use of hydraulic machines for electric power generation is a source of cheap, clean and pollution-free energy.

For the creation of a hydraulic machine, fluid analysis is needed, in order to understand the condition of the pipes.

A Pelton Turbine is not an old machine that will cease to be used because it is inefficient or unnecessary, it was discontinued due to the fact that using fossil fuel granted an increase in the economy of every country, since this is difficult to extract, among other things, it had a very high value. There is a theory that the use of clean energy generated from the elements is even more expensive than that of fossil waste and it could certainly be priced higher but not precisely for the right reasons. This factor is variable with respect to the market and the facilities of rulers, since knowing that the use of these machines (among others that are not precisely hydraulic but also wind-based, thermoelectric, etc.) will reduce the electrical consumption of inhabitants provided by government agencies, which will generate losses in the economy of the country, or at least that is what people believe, and in this way, clean energy generating machines have increased in price, also due to the inflation in the country.

In consideration of our rational thinking, we believe that the machines previously proposed to generate energy can be used today, since oil and other resources for the generation of electricity will be exhausted one day, as a result of one of the most important phenomena which has been increasing year after year, that is, overpopulation.

Thus, measures should be taken to generate electricity in other ways, and when the entire resource has been exhausted, then, it is better to start from this moment to take preventive measures and not at some point turn to corrective actions.

Background

Observing the increase in electricity rates, as well as the inflation in the country due to the rise in the oil prices, which we export cheap and import expensive, we look for a sustainable solution using hydraulic machines previously used to generate electricity in an economic way, as a measure to reinforce jobs that require the use of electrical energy in the industrial process of floriculture; and more than just making use of these resources, we consider the decrease in pollution.

We do not know exactly who, where or how long ago people began to take advantage of the force and energy of a fluid stream; however, it is considered that the inspiration came when irrigation was known.

In ancient times, various means were used to raise the fluid of rivers to a height greater than that of its margins, from where it would run through ducts and ditches to the fields. The Persian or saqia wheel is known as an example of this. It consists on a large wheel mounted on a horizontal axis with spoons on its periphery. These wheels can still be seen working in Egypt, coupled to gears and moved by a buffalo, donkey or camel; thanks to the observation made when unhooking the mobile unit, which was some kind of animal, the movement of the wheel still persisted, so people considered that the fluid had its own energy.

The Romans knew and used hydraulic wheels as a source of mechanical force for their wheat mills, even though they did not exploit the energy of the fluid stream extensively.

The most used hydraulic wheels that worked mainly through the weight of the fluid, being the most functional and convenient, were also the first turbines that men built. The first hydraulic wheels were possibly built in Asia, China and India, about 2,200 years ago; from Asia, they went to Egypt and from there to Europe, after 700 years and later to America.

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The best inventors of the time, such as Leonardo Da Vinci, Galileo and Descartes, among others, conducted mathematical theoretical studies on hydraulic wheels. Parent, a French physicist and mathematician from Paris and a member of the Royal Academy of Sciences, studied for the first time the operation of the hydraulic wheels and correctly anticipated that there is a relationship between the speed of the wheel and the speed of the fluid. By improving the common wheels, the construction of the impulse and reaction wheels resulted in the advantage of using kinetic energy and, with this, reducing their size. The following figures show the main types of hydraulic wheels and their evolution in accordance to their uses.

Problem Statement

As a fundamental part in the use of renewable energies for implementation in the economy of the country, we considered reusing hydraulic turbines in our region, since we can assert that the uses of fossil fuel energies among others in our country have increased numerically every day.

Objective

To build a Pelton Turbine in order to assist in floriculture systems.

Justification

It consists of the creation of a Pelton Turbine to generate energy using a renewable and inexhaustible fluid, whether it comes from rivers, lakes, lagoons, waterfalls, among other water sources on the planet, in order to cut back on the consumption of electrical energy of any industry or business, as well as to create awareness in the community regarding excessive use of electrical energy.

Scope and limitations

Within the expected scope is the fumigation pump to power, so our turbine should generate at least a total of 12v, which will power the pump and, in case of having higher voltage, this would be responsible for charging the batteries that would be integrated into the turbine, which solves one of our limitations related to the fluid, since it does not run daily and by also storing the energy, we assume that the times in which the turbine would be used may not be the same for the pump.

In our scopes we can list the results of the tests:

1. 6V to 1A
2. 16V to 2A
3. 20V to 3A

Considering as a conclusion that this will power the stationary fumigation pump, but, in turn, a problem arises related to the load circuit, which was designed for a maximum of 16V and having the final results, this would not be adequate and other measures would be necessary.

Hypothesis

The design of the Pelton Turbine will be adequate to power a stationary fumigation pump of 13V, or at least, to charge the battery.

Methodology

Place:

The research project was carried out in the municipality of Tuxpan in the town called Lombardía de Guadalupe, thanks to its people who plant flowers, peaches and avocados, they allowed us to conduct our study in the flower greenhouses. We use the irrigation fluid from the greenhouses for the implementation of the machine..

Construction:

- 5mm steel sheet
- 5.6cm plate
- Forks
- Engine
- Steel rotor
- Screws
- Welding
- Batteries
- Components for load circuit
- Motorcycle or bicycle chain or bands
- Metal gears
- Cables

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Figure 1 Turbine Construction

Start up:

To perform the field test, it was necessary to check the fluid that ran through the irrigation channel from which the fluid would be taken. For this, we made sure that they did not have any dam that would obstruct the passage of the fluid.

Figure 2 Start-up of Pelton turbine test 1

The second test differs from the first test because it was performed in another location, thus changing the factors obtained in test 1. To begin with this test, we needed to check that the hoses were installed in the irrigation channel from where it would be taken and that the pipes were not blocked. As we learned from test 1 and its mistakes, we learned how to make the correct couplings in our reductions to avoid leaks, but still, without considering important aspects such as the falling pressure, among other things, we found leaks in the different couplings, hence reducing the pressure obtained at the outlet.

Figure 3 Start-up of Pelton turbine test 2

Results

The following voltage results were obtained after conducting the experimental investigation. We considered several aspects to reach these results, such as the elevation of the pipes, the distance and the pressure; we should have considered these aspects since for better experimentation and analysis of our results.

First test:

The pressure we measured with the pressure gauge before connecting the nozzle to our turbine was 20PSI, when analyzing the amount of pressure we had, we concluded that this would not be enough to lift our turbine, or that it would not be enough to generate the 13 volts necessary to feed the fumigation pump, this would mean that our hypothesis would not be satisfied by this pressure.

Another aspect that should be considered is the elevation and distance that we have from the intake of our fluid through the hoses until the end of the nozzle attached to the Turbine. In this first test, the distance was of approximately 50m from the dam, so that the flow was greater and thanks to the reductions of the pipes the pressure would increase, until it reached the turbine.

These data, obtained before taking the measurements with our multimeter, showed us that the factors did not meet the requirements and therefore would not comply with the established hypothesis.

Second test:

Our final pressure was greatly increased, obtaining a total of 40PSI at this location, which, compared to the initial test, was doubled. The conclusion established in test 2 was recognizing the importance of distance and elevation to increase pressure.

Third test:

This section will show the third test that was carried out in the field. On this occasion, and having done previous tests, we got experimental learning from the mistakes previously made, such as the loss of flow, which is the amount of liquid that is obtained in a pipe, this can be obtained through the area with respect to speed, but for a better experimental understanding we used volume over time.

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We also mentioned the loss of pressure, which could be lost through leaks in the connections and couplings of the pipes. Another aspect considered in this test was the garbage that entered our pipe, which could be causing clogging and thus prevent the liquid from flowing correctly and even generate pressure at other points and cause breakage. This was solved by installing in the dam a wire fence with very small dimensions, that is, in what would be our tank.

Figura 4 Puesta en marcha turbina Pelton prueba 3

For the current test, we made the final improvements to our Turbine, which are:

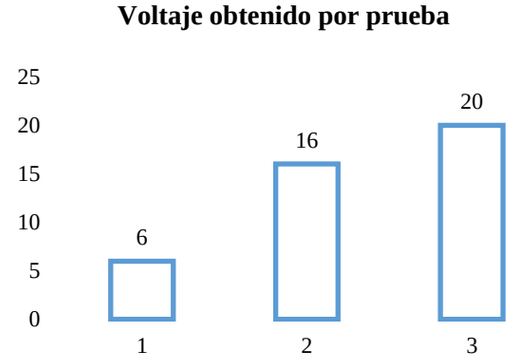
Integration of batteries for charging; The 12 volt batteries were integrated so as to not necessarily activate the Pelton Turbine to use the fumigation pump. These would be charged by operating the instrument and, in turn, the pump could still be powered.

Protective cover; This cover is responsible for covering the turbine to avoid fluid losses, since water impacts the cover, it falls through the walls and is introduced again into the irrigation channel or well in which it is installed.

For the installation of the batteries, a charging circuit must be assigned; this was created by analog electronics, a subject taken during this semester. The circuit that we prepared was an indicator of two states, which was developed for a maximum of 16 volts and a minimum of 3volts, since we obtained these data in the previous tests.

	1ª prueba	2ª prueba	3ª prueba
Distancia	500 m	500 m	500 m
Presión	20 PSI	40 PSI	50 PSI
Voltaje	6 V	16 V	20 V
Corriente	1 A	2 A	3 A
Potencia	6 W	32 W	60 W

Tabla 1 Resultados de pruebas



Graph 1 Voltage obtained per test

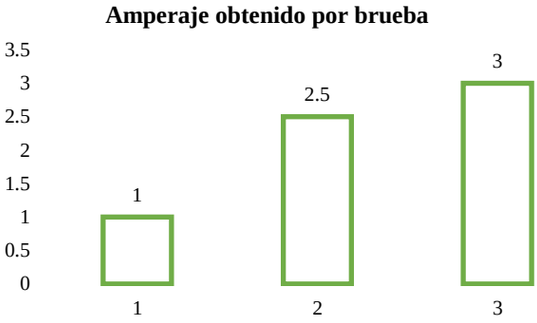


Gráfico 2 Amperaje obtenido por prueba

Conclusions

From the tests carried out during the implementation of this project, we can state that through the designed Pelton turbine sufficient electrical energy was generated to supply a small producer; however, everything should be considered by the scale of the prototype and the water effluent. In conclusion, the prototype is ideal for generating electricity in the conditions already presented.

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Documentation of the marketing, maintenance and financing processes for an agribusiness company in southern Sonora

Documentación de los procesos de comercialización, mantenimiento y financiamiento para una empresa de giro agroindustrial del sur de Sonora

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Abstract

Organizations that want a high competitive level are in the search for the standardization of their processes with the formalization of their activities, using tools that adequately contribute to their correct performance. The project was developed in an agribusiness company in southern Sonora, which lacks the documentation of the processes, which does not allow a clear definition of the functions of the different positions. For this purpose, the objective of documenting the marketing, maintenance and financing processes to standardize the activities carried out in them was established. The procedure was structured by the following steps: elaborate the process map of the company, determine the processes to document, obtain the current practice, define the format to document, elaborate processes in draft, validate the processes and finally correct and deliver them for use. At the end of the project, the standardization of the activities was obtained through the documentation of the commercialization, maintenance and financing processes of the company, thereby obtaining the means of support for the effective and efficient operations of the processes, which impacts in satisfying customer needs.

Standardization, Documentation, Improvement

Resumen

Las organizaciones que quieren un alto nivel competitivo están en la búsqueda de la estandarización de sus procesos con la formalización de sus actividades, utilizando herramientas que contribuyan adecuadamente en el correcto desempeño de estos. El proyecto se desarrolló en una empresa de giro agroindustrial del sur de Sonora, que carece de la documentación de los procesos lo que hace que no permita una clara definición de las funciones de los distintos cargos. Para ello se estableció el objetivo de documentar los procesos de comercialización, mantenimiento y financiamiento para estandarizar las actividades que se realizan en ellos. El procedimiento se estructuró por los siguientes pasos: elaborar el mapa de procesos de la empresa, determinar los procesos a documentar, obtener la práctica actual, definir el formato para documentar, elaborar procesos en borrador, validar los procesos y finalmente corregir y entregarlos para su uso. Al finalizar el proyecto se obtuvo como resultado la estandarización de las actividades a través de la documentación de los procesos comercialización, mantenimiento y financiamiento de la empresa, obteniendo con ello el medio de soporte para las operaciones efectivas y eficientes de los procesos, lo cual impacta en la satisfacción de las necesidades del cliente.

Estandarización, Documentación, Mejora

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Introduction

Agriculture in Mexico is considered one of the main activities that provide greater relevance to the country's economy, generating a large amount of employment; and it is considered as the most important productive sector from a social, economic and environmental point of view, since it depends on the food of millions of people. Agribusiness is the economic activity that includes the production, industrialization and commercialization of agricultural products, forestry and other natural resources (Shared Risk Trust, 2017), this sector requires the addition of value to the products of the agricultural industry.

Mexico leads in the agribusiness sector for understanding the production, industrialization and commercialization of agricultural, forestry and biological products; thus contributing value to agricultural products generating durability and availability, especially those that are more perishable. (Shared Risk Trust, 2017). The importance of agribusiness in Mexico served as the main activity, placing it at a high level compared to the world, being one of the main exporters of food abroad.

The companies of this agroindustrial turn were in the need to make changes and implementations of quality management systems, as well as the standardization in the processes and control of their operations, that is why to the general economy and mainly to this type of industry, has given them good results and in a very productive way, the validation of measures and general parameters in their processes and procedures.

According to Saavedra and Hernández (2008), they establish that the economic importance of MSMEs (Micro, Small and Medium Enterprises) stand out in the fact that it fulfills a role of great relevance in the generation of employment, reaching an average of 64.26% of the total jobs. The importance of medium-sized companies has increased greatly since they are more than half of the employment generators, thus being vital for the region's economy.

The company under study classifies in this area, is of the agribusiness and is dedicated to the marketing of grains and financing; It has three plants located in different parts of southern Sonora in the northwest of the country with a total of 130 employees.

It was founded at the beginning of the year 1996, was born by the commitment of its founders, with and for the development of the primary economy in In the region, they are very clear about their vision that growth must be created for the benefit of producers and consumers, working together in their development, being of their main activities the financing of small, medium and large producers, collection and marketing of grains, seeds , fatty pastes and oils, as well as the conservation and safe storage thereof.

The organization has a young, enterprising, professional, prepared, updated and long-term vision team. In each of the business contacts with producers, they will find in the organization a reliable team to build long-term relationships, with win-win training, with the security of commitment and the search for solutions that support the producer.

Its mission is to be the best option of the agricultural producers in financing, commercialization and to give added value to their products, to obtain a professional and human growth of all the members of this one; He also has a vision which states that he wants to become a leading company in the northwest and west of Mexico in the Agroindustrial activity.

It has a series of objectives, which are to support the agricultural sector with more appropriate financial alternatives, ensure the supply of raw materials and finally have a continuous improvement in the company's processes. Likewise, it has values that ensure the commitment, honesty, loyalty, participation, spirit of service and teamwork of all its members.

Having documented processes is a vital necessity in an organization, since it talks about the maturity that it has and its competitive level, it is a section of the ISO 9001: 2015 standard, organizations that are certified with such regulations have to comply with the different sections it contains and one of the most important is the documentation of the processes it has. In the company under study there are more than 10 processes, of which none is documented.

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Problem Statement

Organizations that want a good competitive level are in the search for the standardization of their processes with the formalization of their activities, using tools that adequately contribute to their correct performance. The company under study lacks the documentation of all its processes, which does not allow a clear definition of the functions of the different positions. Likewise, there is no physical support that validates the activities and procedures that are carried out in it.

When a new member of the organization enters to work, it is necessary to have a support in physical that helps him to realize his correct work of his functions. Given the above, the following is proposed: there is a need to document the marketing and maintenance processes of an agribusiness business as it does not have the standardization of its activities.

Objective

Document the marketing and maintenance processes of an agribusiness company dedicated to the sale of grains, to standardize the activities carried out in them.

Justification

With the implementation of process documentation it is intended to obtain three processes with specific and standardized activities. The main beneficiaries will be the company since it will have the formalization of its activities and the operators that will have a document with work instructions and will be part of their intellectual property. And the other beneficiaries would be the workers as it will reduce ambiguities, confusion or ignorance of the process. In case the established activities are not followed, the process can be unintentionally or accidentally altered, thereby causing loss of matrices.

Theoretical framework

The theoretical aspects that support the investigation for the documentation of the processes are shown below.

Quality management system

The quality management system is a means that is useful not only to give confidence that the product or service will meet certain specifications, but also to reduce operating costs. Every quality model seeks that "things are done well the first time"; This creates an organizational culture that minimizes waste, avoids reprocessing and optimizes the use of inputs. More than a simple method for minimizing costs, this also becomes a driver of increased productivity in organizations (Servat, 2005).

The quality management system is one of the most implemented management systems in organizations worldwide. Any organization that is willing to implement the ISO-9001 standard must know and take into account the principles and foundations that underpin the Quality Management System. Otherwise the expected results may never be achieved, thus being a problem for the organization (ISO-9001, 2015). According to ISO 9001: 2015, it establishes that the organization must agree on the necessary processes for the Quality Management System and its application throughout the organization, and must:

a. Establish the required inputs and expected outputs of such processes.
b. Determine both the sequence and the interaction of these processes.
c. Determine and apply the criteria and methods necessary to ensure the effectiveness of the operation and control of these processes.
d. Stipulate the necessary resources for these processes and ensure that they are available.
e. Assign responsibilities and authorities for these processes.
f. Evaluate such processes and implement the necessary changes to ensure that these processes achieve the expected results.
g. Improve processes and the Quality Management System.

Documentation

Folgar (1998), establishes that a document is any information medium that holds certain formalities, the minimum formalities must gather an information medium to be constituted as a document are the following:

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- It must be useful for doing, not doing or trying something.
- It must be recognized as a document by everyone involved.
- The information contained in it must be consistent.

Its purpose is to provide objective evidence that the processes have a systematic planning, consistent elements for their execution, controls that facilitate the obtaining of records and, finally, that there are established mechanisms to improve each process. A document consists of official statements and / or diagrams and / or other images that can be used to provide authorized information. The initial documentation can be written or stored on paper or in an electronic or computer medium, for the purpose of preserving knowledge (Lamprecht, 2003).

Process documentation

The documentation of the processes over time becomes a necessity that was adapted to the level of the organizations for its continuous improvement and thus being a requirement for its correct productive functioning. One of the main drawbacks in companies, which generates a significant decrease in their productivity, is that their members do things in different ways without following a unique and uniform methodology. Everyone appeals to their own criteria and most of the time is not the best, in situations many lack that experience. For this reason, the results, when obtained, tend to differ between pairs, similar areas or plants (Gutiérrez, 2010).

There are tools and ways to reduce the above in a significant way, one of them is the documentation of processes through which a trained person can identify the optimal method to execute a certain process, justifying the use and importance of applying the documentation of processes in projects and programs to carry out their realization (Carballo, 2012). The documentation of processes is an activity of great importance to be able to obtain standardized processes and to delimit the activities of each person in a certain time, otherwise people perform things differently without following a formal practice, generating rework, loss of time increase in costs and minimizing the efficiency of processes (Ayuso, 2008)

Having documented the processes that are carried out within an organization, is a fundamental requirement in any solid quality system since it is the one that defines its strategy. However, it is believed that the deployment (extended use of the process) and the results (benefits obtained from the execution of the process) are equally important (Vavra, 2000).

The norm ISO TR 10013 (ISO, 2001) establishes that under the international norms ISO the guidelines that facilitate the documentation of quality management systems are expressed, it guarantees to the organizations to be able to incorporate their documentation in an agile, transparent way and under any system, for the purpose of operation, maintenance, continuous improvement based on the structure to document processes.

Process documentation guides a standardized process as it is one of the best ways to organize and manage the way work activities are carried out to create value for the client and other interested parties. It is shaped as a procedure that is under the supervision of the results of quality auditors, but to achieve this result it is necessary to make a process documentation and to be a really authentic and easy-to-use tool it is necessary to take Consider the following aspects (Velasco, 2009):

Benefits of the documentation

The ISO 9004 Standard indicates that the documents are useful to support an effective and efficient operation of the organization's processes, and also contribute to satisfying the regulatory and contractual requirements of customers and stakeholders (Esponda, 2004).
The main benefits obtained by companies that carry out documentation activities are (Esponda, 2004):

- All the components of the system are written down, which facilitates their dissemination and understanding.
- Communication between those involved and the controlled access of all documents is improved.
- The execution of activities is disciplined and standardized and therefore, improvisations, errors are eliminated and work is done in a more orderly manner.

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- The records provide objective evidence to know the actual behavior of the processes and thus identify opportunities for improvement.
- There are elements that allow generating collective learning about failures and defaults.
- With the quality policy, the work of the employees acquires greater meaning and contributes directly to the achievement of the objectives that have been set and shared.
- Many risks are avoided due to people's memory problems, since everything is written. The documents are updated and available, and the obsolete ones are not used but the current ones.

Process map

According to Miranda (2006), the mapping of processes is a methodology that allows to guide and redefine the main elements of the process for the reinvention of the same according to what the client considers of value. For Render (2004), process mapping is a tool that has the purpose of offering an objective and structured way to analyze and record the activities that make up a process, this allows focusing attention on activities that add value.

This means that a process map is a methodology that allows to guide and define the elements of the processes that encompass a company, organizing each of these in 3 specific areas according to their function, they can be strategic, key or missionary and support.

Benefits of the process map

For the process map there are multiple benefits since it is a graphic tool that allows establishing the necessary strategies to solve the needs of the clients (internal / external). It allows highlighting the main obstacles and opportunities that may arise within and outside the company, some of these benefits are shown below (Miranda, 2006):

- Show relationships and roles.
- It provides a global vision.
- It helps explain the process.
- It allows to identify the procedures and work instructions that need to be documented.
- It helps to simplify the activities of the process, as it facilitates the identification of unnecessary complexities or repetition of tasks.
- Process standardization aid.

Process

There are many ways to define what a process is, one of the simplest responds to what Pérez (2012) establishes and affirms that it is an orderly sequence of repetitive activities whose product has intrinsic value for its user or client. According to ISO 9000 2015, it establishes that a process is the set of activities linked to each other that start from one or more inputs to transform them into outputs, thus generating results. It should be noted that organizations are generally made up of different processes to make it work and work in a continuous way.

Types of process

The processes can be classified by understanding different criteria, in practice we talk about three that are shown below (Martínez, 2013).

- Strategic processes. They constitute guides and guidelines for the Operational and Support Processes. Within this classification are the management or administrative processes of the organization. They manage the way to make decisions about planning and improvements of the company.

- Key processes. They create value and have an impact on the end customer, they are the product realization processes. They are also called operational and missionary. They manage the activities that lead to the delivery of the product to the customer, since they are those processes typical of the company's activity from which the customer will perceive and value the quality of the good or service.

- Support processes They give support or support to the key processes. Its value is indirect and generally its customers are internal. They provide necessary resources so that key processes can be carried out

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Methodology to be developed

To carry out this process documentation project, seven steps were established, which were adapted from the methodology proposed by Alexander (2005), which are described below.

Develop process map

For the realization of this step it was necessary to identify the processes that the organization has, carrying out a meeting with the Director of the plant, organizing the processes in 3 sections, identifying if they were strategic, key or support processes.

For this, a list of processes which belong to the organization under study was prepared, and for its structuring, examples of process maps were taken into account and where these processes are located, likewise the processes granted by the organization were positioned.

Determine the processes to document

To carry out this step, it was necessary to convene a meeting with the director of the organization, the process map was presented and the processes with the greatest need to be documented were determined, the stages containing each one were defined by an approach of processes of its activities and resources, this in order to guide a achievement in the processes to be documented, which were presented in a list.

Determine current practice

To know this, it was necessary to take a tour of the specified areas and attend pre-established appointments with the main managers of the areas, observe the activities that are carried out in each process. In this step, the interviews were recorded to facilitate the collection of the information and with this, notice the way in which their daily activities are carried out, for their development, a questionnaire was designed where the maintenance area managers were interviewed and marketing, with this information then make a cross-function diagram.

Define the format

For the definition of the format for documenting, formats already elaborated in different internet sites, books and approved works were searched and compared to each other for the creation of their own, each format requires a specific registration number for this purpose the Guide was used to ISO TR 10013 document coding. After its completion, a board of directors was held for validation.

Prepare draft processes

This step was carried out by means of the total analysis of each process, documenting each one of the activities that are carried out in the processes detecting areas of opportunity and those involved, the document format for documenting processes was filled out and a list of the steps, also cross-function diagrams were developed for each process and were designed in igrafx version 2013.

Validate processes department managers

To obtain the approval of the final documentation, the results of the documentation must be delivered to the department managers. So that in this way they are reviewed and approved to receive authorization for delivery. In the event that managers indicate any correction, the documents will be analyzed again, and the pertinent corrections will be applied for a better understanding and application of the same, the corrections will be shown in a table.

Prepare corrections and deliver validated processes

In this step we proceeded to review the comments made to each of the documented processes, then make the pertinent corrections to the documents and also authorize the delivery of the documents for the proposed implementation. Delivery implies delivering a printed document to each head of the area with its specific process, as well as delivering a copy of both processes to the company's director.

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Results

The following describes the results that were obtained when documenting the maintenance, commercialization and financing processes, and that were generated during the present investigation.

Elaboration of the process map

With respect to the meeting with the plant director, a list was obtained with the processes that make up the organization, carrying out a process map. (See figure 1).

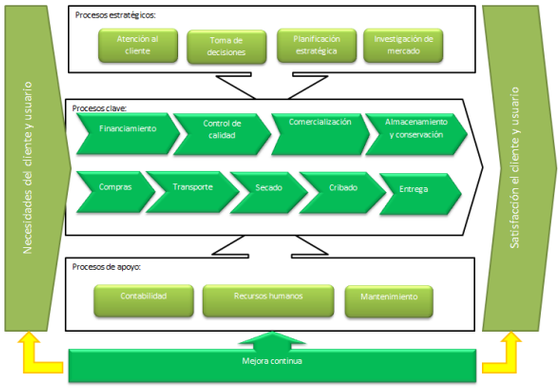

Figure 1 Organization process map

For the classification of the processes that make up the company, different process maps were taken and according to those that were in each of the areas (strategic, key and support), they were positioned based on their type. It is observed that in the strategic processes they are made up of four in total, customer service, decision making, strategic planning and market research; In relation to those classified as key, nine are located in which they are: Financing, quality control, commercialization, storage and conservation, purchases, transport, drying, screening and delivery; and finally in the support shows the process of accounting, human resources and maintenance.

Determine the processes to document

Based on the information obtained in the review of the processes of the organization under study established in the process map, an agreement was reached in the working meeting with the Director that two key processes and one of support or support would be documented, due They are critical processes that impact the company's mission.

A list was generated in which the processes to be documented were established, which can be seen in Table 1 below..

Type of processes	Process
Key	Commercialization Financing
Support for	Maintenance

Table 1 List of processes to document

The previous Table shows that the choice was according to the needs of the organization, all areas were taken into account since all the processes lack their documentation, two key processes were selected: commercialization and financing, and one of support: maintenance, since they were the processes with the greatest need.

Determine current practice

A tour of the entire plant was made in order to know how the company works and what its areas are, with this it was determined what is the current practice of the selected processes applying the established interview format and thus developing a cross-function diagram (Flowchart), thus clearly defining the activities that correspond to each process and having an established order. The result of this step is contemplated in section VI of the format document to document each process, which is called FLOWCHART.

Define the format

To carry out this step, we searched for examples of formats to document processes on different websites, books, theses and ISO TR 10013. Subsequently, a comparison of the elements presented in each document was made and a proposal was prepared. of format for the company under study, which was presented at a working meeting with the Director of the company and the owners of the processes for validation and approval.

The format for documenting processes was carried out based on the requirements of the organization, the following Figure shows the points to be evaluated and the sections thereof (See Figure 2).

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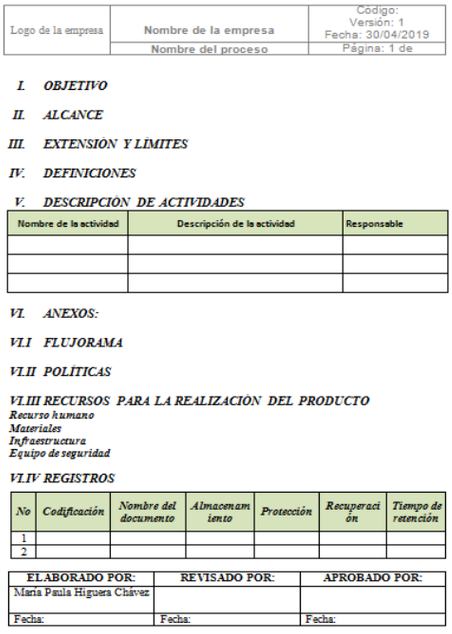

Logo de la empresa	Nombre de la empresa	Código: Versión: 1 Fecha: 30/04/2019
	Nombre del proceso	Página: 1 de

I. OBJETIVO

II. ALCANCE

III. EXTENSIÓN Y LÍMITES

IV. DEFINICIONES

V. DESCRIPCIÓN DE ACTIVIDADES

Nombre de la actividad	Descripción de la actividad	Responsable

VI. ANEXOS:

VI.I FLUJORAMA

VI.II POLÍTICAS

VI.III RECURSOS PARA LA REALIZACIÓN DEL PRODUCTO
Recurso humano
Materiales
Infraestructura
Equipo de seguridad

VI.IV REGISTROS

No	*Codificación*	*Nombre del documento*	*Almacenamiento*	*Protección*	*Recuperación*	*Tiempo de retención*
1						
2						

ELABORADO POR:	REVISADO POR:	APROBADO POR:
María Paula Higuera Chávez		
Fecha:	Fecha:	Fecha:

Figure 2 Format for documenting processes

The previous Figure shows that six sections were established in which the processes are described in detail. In the first one it is shown that the general objective of the process under study is established, in the second one the scope is analyzed and in the third the extension and limits thereof, in the number the necessary definitions are presented so that any person who does not know the vocabulary established in the area, be guided from there to understand it. Section five establishes the description of the activities, the name of the activity and who is responsible for it and finally in point six are the annexes, which include the flowchart, process policies, resources for carrying out of the product and records. These were established as the necessary points to describe in detail the selected processes.

Drafting processes

The documentation of three specific processes was prepared, according to the level of requirement of the organization, the areas and types of processes were taken into account, given that the key processes obtained greater relevance:

– Commercialization
– Financing
– Maintenance

With the determination of the current practice of the maintenance process, deficiencies were found and a lack of documentation for the records of some of the activities, given that a series of proposed machine / equipment records and work plan was established. For the financing process, the reduction of re-work was proposed using only one person in charge in this area, standardizing their activities. And for the commercialization process all data and records were captured, thus proposing a standardized process.

Process validation by department manager

The feedback of the 3 proposed processes was obtained by those in charge of each documented process, where the sequence of activities was verified. The observations and comments were recorded in a format in which the name of the process and the corresponding comment were indicated (See Table 2).

Process	Observation
Maintenance	– Add "Predictive Maintenance" to the definitions. – Add the predictive maintenance question to activity 4.
Financing	– Modify the objective. – Change of names of those responsible for the activities, in activity 1 it is the promotion area, in 2 it is a credit assistant, in 10 it is the paraffinance area, in 11 it is the parafinancial manager, in 19 it is agricultural insurance and at 21 he is again the paraffinance manager.
Commercialization	– Add attachments – Change responsible names. – Confidential annexes. – Modify the documentation name.

Table 2 Process Feedback

Correct and deliver validated processes

Based on the review of the observations granted by the heads of the processes, the proposed corrections were made to each of them, and then handed them over to management and that it made delivery address. The following is a list of the 3 documented processes obtained (see Table 3) and their documentation (see Figure 3):

Process	Name	Key
1	Maintenance	MT-PD-01-00
2	Financing	FN-PD-01-00
3	Commercialization	CM-PD-01-00

Table 3 List of the 3 processes and their keys

Logo de la empresa	Nombre de la empresa	Código: MT-PD-01-00 Fecha: 20/05/2019
	Proceso de mantenimiento	Página: 1 de 9

I. OBJETIVO

- Mantener la infraestructura, máquinas y equipo, con las condiciones óptimas para lograr la conformidad con los requisitos de la organización.

II. ALCANCE

- Este proceso es aplicable para cubrir el servicio de mantenimiento de la Infraestructura y equipo de ALINSUMOS S.A. de C.V. abarca el mantenimiento de todas las áreas físicas de las instalaciones y la restauración de todos los muebles y equipos de propiedad de la organización.

III. EXTENSIÓN Y LÍMITES

- Límites del procedimiento: Inicia.- En el momento en que se elabora la programación anual de mantenimiento preventivo y predictivo . Termina.- Cuando se concluye con la reparación y mantenimiento preventivo de los bienes o cuando se da de baja algún bien por obsoleto.

IV. DEFINICIONES

- ***Mantenimiento***: conjunto de actividades realizadas a un equipo o instalación para que éstos sean conservados o restaurados y tienen como fin incrementar su tiempo de vida útil, además de asegurar su correcta operación, funcionalidad y eficiencia energética.
- ***Mantenimiento predictivo:*** técnica para pronosticar el punto futuro de falla de un componente de una máquina, de tal forma que dicho componente pueda reemplazarse, con base en un plan, justo antes de que falle. Así, el tiempo muerto del equipo se minimiza y el tiempo de vida del componente se maximiza.
- ***Mantenimiento preventivo:*** conjunto de actividades de mantenimiento realizadas a un equipo o instalación con el fin de prevenir, detectar y corregir fallas, evitando así descomposturas o daños mayores tomando en cuenta las recomendaciones del fabricante y la experiencia del personal responsable: rehúso de los residuos sólidos, sean tratados previamente o no.
- ***Mantenimiento correctivo:*** conjunto de actividades que consisten en el reacondicionamiento o sustitución de partes en un equipo o instalación una vez que han fallado, es la reparación de la falla (falla funcional), ocurre de urgencia o emergencia.
- ***Plana de mantenimiento:*** conjunto de tareas preventivas a realizar en una instalación con el fin de cumplir unos objetivos de disponibilidad, de fiabilidad, de coste y con el objetivo final de aumentar al máximo posible la vida útil de la instalación.

Figure 3 Documented Maintenance Process

Conclusions

In the course of this investigation the conclusion of the great importance of the documentation of the processes in an organization was reached, since thanks to them it is possible to obtain great objectives such as: the standardization of the activities of the process, staff training, add value and knowledge to the organization.

These documents are part of a means of support for the effective and efficient operations of the processes, which in turn is part of the achievement of the satisfaction of the needs of the client and interested parties.

This project met the objective of documenting the marketing, maintenance and financing processes of an agribusiness company dedicated to the sale of grains, to standardize the activities carried out in them.

It is considered that the maintenance process has a complex standardization since this process covers the needs of the organization as a whole, is found from the facilities of the entire plant, to the machines used in the different processes, even though the activities were considered general of this process thus carrying out proposals for changes in record formats facilitating the process, this carries out the acceptance and approval of the document by the head of maintenance.

In the financing process it has a logical standardization since if the same process is not followed, it reaches rework, and for someone outside the process to achieve optimal training.

And finally, for the commercialization process, improvements were made according to the guidelines followed by ASERCA, annexes were organized and improvements to the process were proposed to make it more efficient.

In the development of the project there were limitations such as the flow of information, given this causes the documentation to be more delayed and complex. Despite this, the three processes were documented.

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* Correspondence to Author (example@example.org)
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Text in Times New Roman No.12, single space.

General explanation of the subject and explain why it is important.

What is your added value with respect to other techniques?

Clearly focus each of its features

Clearly explain the problem to be solved and the central hypothesis.

Explanation of sections Article.

Development of headings and subheadings of the article with subsequent numbers

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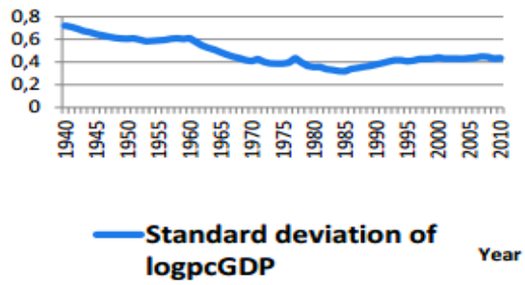
Including graphs, figures and tables-Editable

In the article content any graphic, table and figure should be editable formats that can change size, type and number of letter, for the purposes of edition, these must be high quality, not pixelated and should be noticeable even reducing image scale.

[Indicating the title at the bottom with No.10 and Times New Roman Bold]



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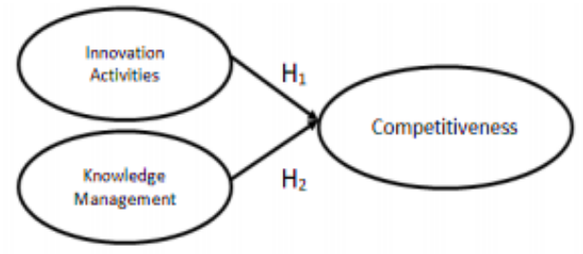

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Methodology

Develop give the meaning of the variables in linear writing and important is the comparison of the used criteria.

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Thanks

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Explain clearly the results and possibilities of improvement.

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